Development of packaged photodiode for use in intra-satellite photonic RF links

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Microwave photonics engineer

Albis Optoelectronics
- Detecting Solutions

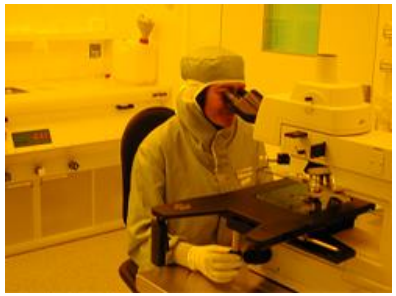
- 20 years of excellence in III-V photodiode manufacturing with **over 40 million photodiodes sold to date**.

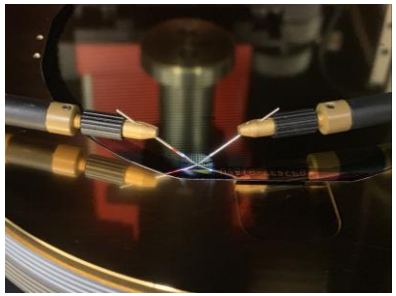
- Designer, developer and manufacturer of high-speed **III-V photodiodes and avalanche photodiodes** based on InP and GaAs.

- Qualified technology and products with long track record of reliability.

- Own **clean room production facilities**
  - In-house front-end to back-end III-V wafer processing and testing.
  - Flip-chip mounting and packaging infrastructure.

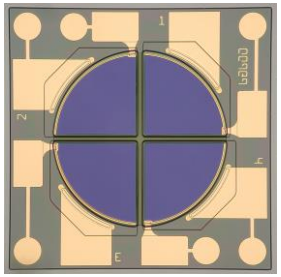
- Design, fabrication and design validation of semi- and full custom specific photodiode chips, chip-on-carrier and packaged photodiodes.



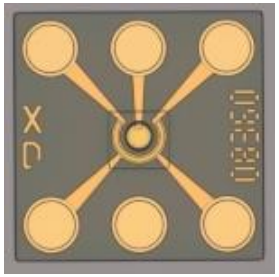


Albis Optoelectronics
- Detecting Solutions

Positioning & Tracking
FSO

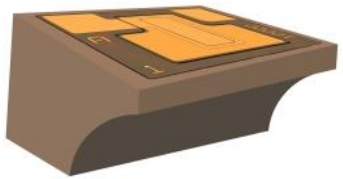


Low noise APD 10G, 25G
digital, FSO

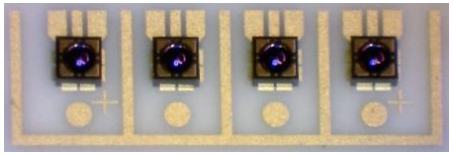


Packaged (high power) PD
Analog RoF up to 40GHz

Monitoring/Sensing/
LIDAR



PD 28G, 56G, 112G, 200G
and balanced detector



PD/APD + TIA ROSA
Digital receiver 10G, 25G

Outline

- Motivation
- Albis space-oriented projects
- Product line up:
  - High power packaged PD (20 GHz)
  - Broadband SWaP packaged PD (40 GHz)
- On-going development
- Conclusion

Motivation

RF photonic payloads:

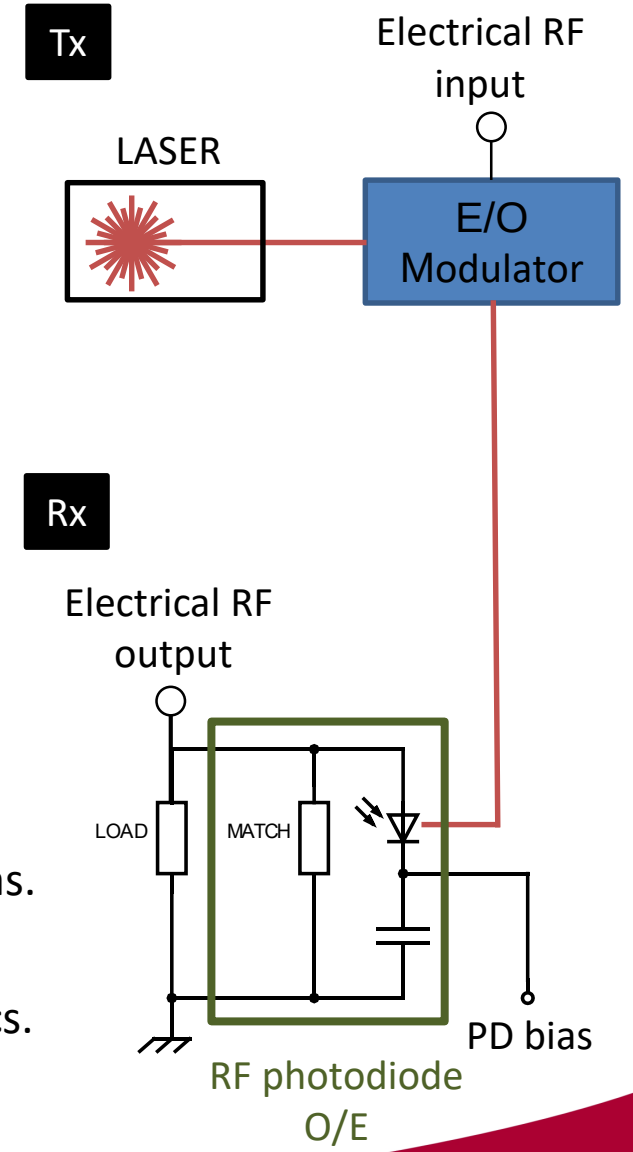
- Low SWaP (size, weight and Power)– Fibre vs. copper;
- RF performance vs. distance;
- Lower susceptibility to electro-magnetic interference.

Analog Optical RF Link Requirements for PD:

- High photocurrent PD operation;
- High photodiode linearity;
- High photodiode bandwidth.

Application:

- RF signal distribution:
  - intra-satellite, ground station, phased array antennas.
- RF signal generation:
  - low noise frequency reference, microwave photonics.



Albis Space-Oriented Projects

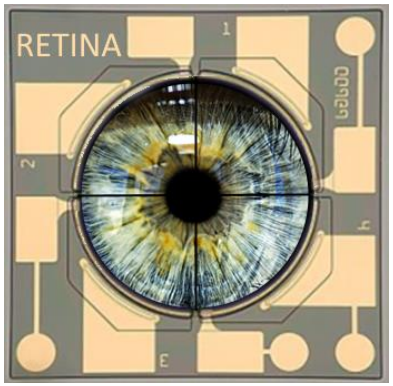
- **HOPP (JUN. 2016 – AUG. 2020), ESA**
  - High power photoreceivers for high dynamic range for high frequency photonic RF links
  - High power PD with bandwidth > 20 GHz
  - Project partners: CSEM

- **SIPhoDiAS (JAN. 2020 – OCT. 2023) HORIZON 2020**
  - Broadband packaged PD (40 GHz)
  - Efficient SWaP package
  - Project partners: ALTER Technology, AXENIX, IHP Microelectronics, LEO Space Photonics R&D, Thales Alenia Space

Albis Space-Oriented Projects

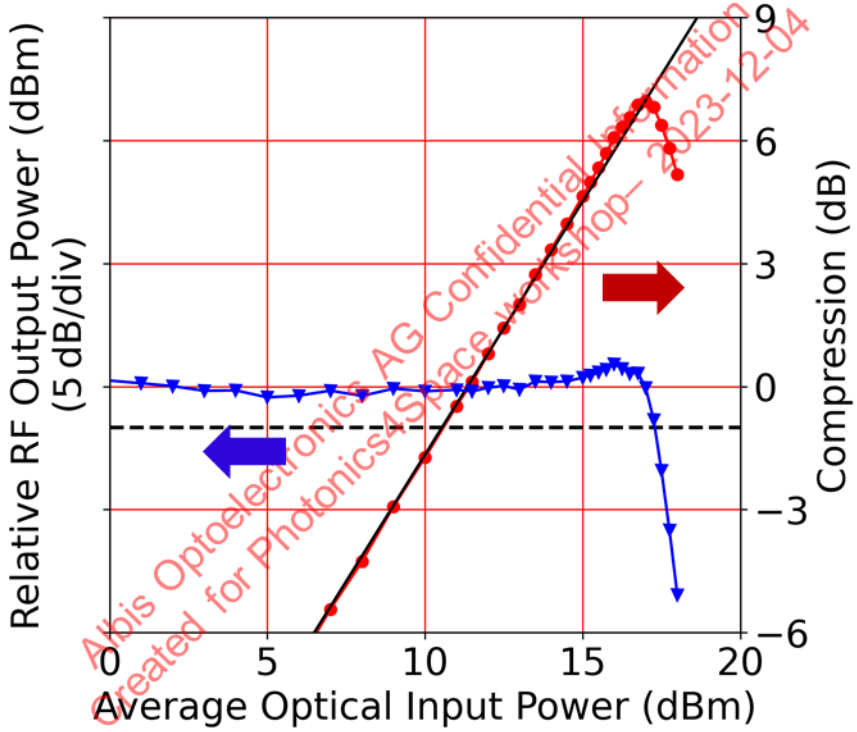
- **BAROC (FEB. 2022 - present), ESA**
  - Broadband (40 GHz) PD and narrowband PD
  - MMIC integration
  - Project partners: Thales Alenia Space

- **RETINA (MAY. 2023 – present), ESA**
  - Quadrant APD receiver
  - Tracking and data transmission up to 10 Gbps



High power packaged PD PQW20B-L

- Bandwidth: 20 GHz
- Responsivity: 0.8 A/W
- RF linearity: 50 mW @ 10V
- Broadband 50 Ohm output
- Internal bias-tee
- Hermetically sealed high-speed package

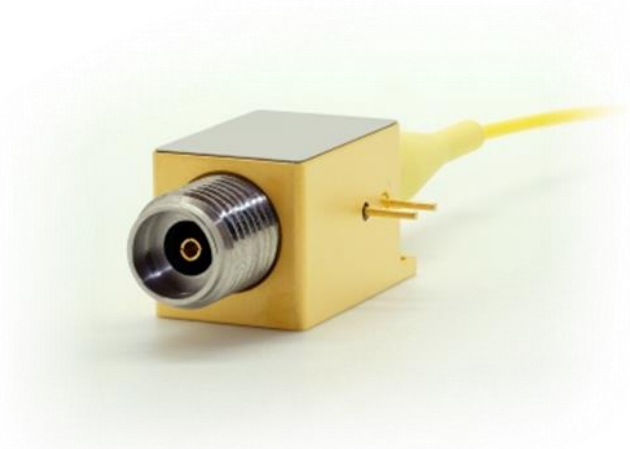


1dB compression point measurement

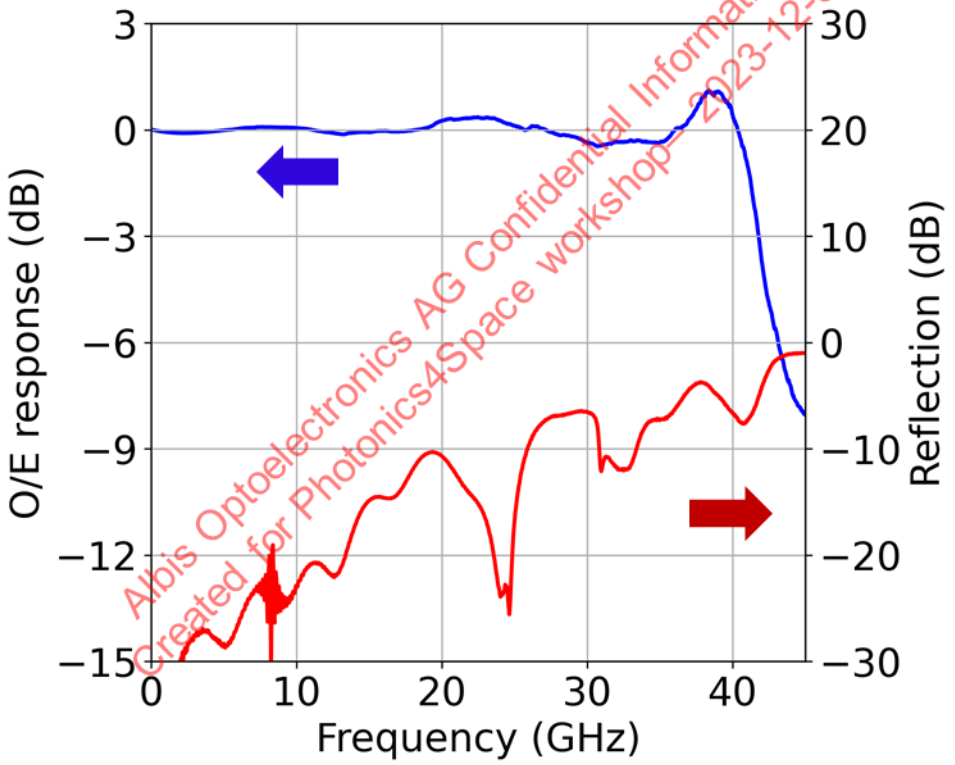
λ = 1550 nm, V_B= 5 V, f = 10 GHz

Broadband packaged PD PQS40A-L

Photodetector with **record-high responsivity and bandwidth** is now available.

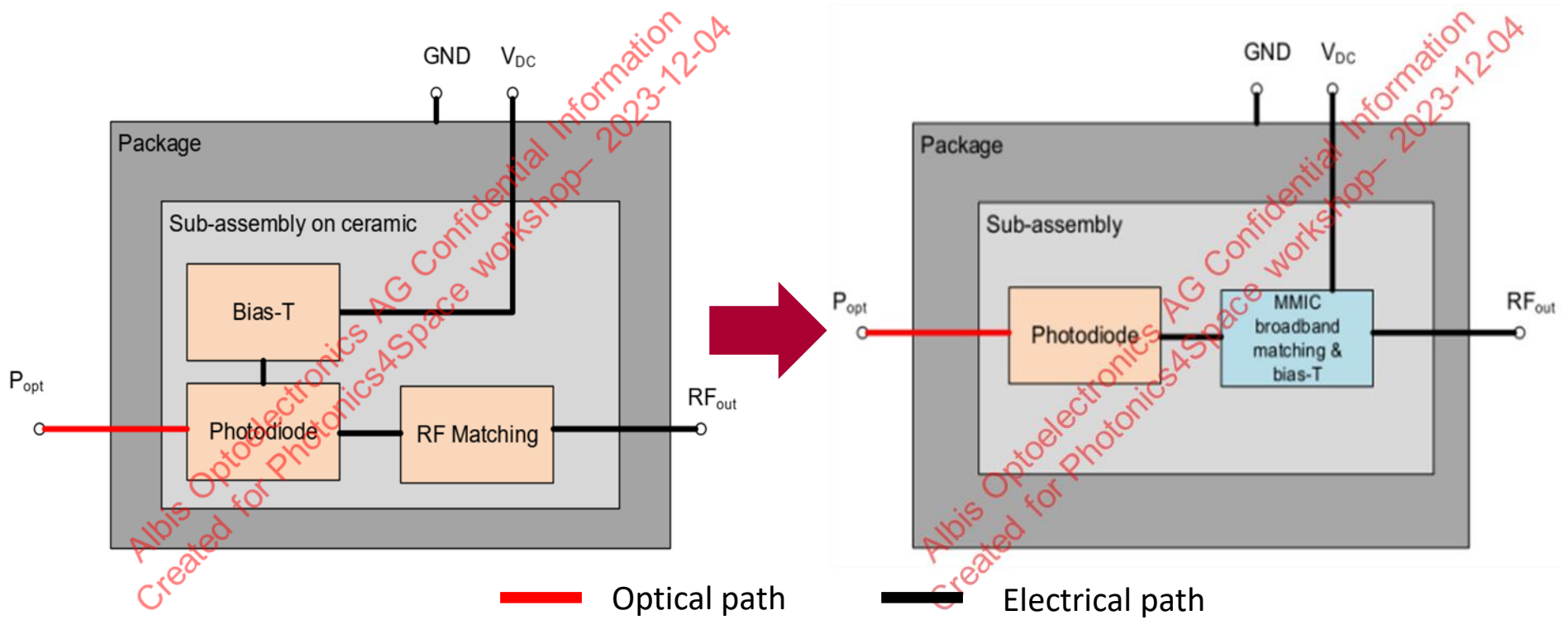


- High bandwidth: > 40 GHz
- High linearity: up to 11 mW
- Broadband 50 Ohm output
- Internal bias-tee
- Compact size (9 x 9 x 19 mm^3, ~ 50 %)
- Low weight (8 g, ~ 80 %)
- Hermetically sealed high-speed package



λ = 1550 nm, V_B= 5 V

On-going development –BAROC–



Size: MMIC enables broadband and complex narrow band matching on small footprint.

Performance: Higher level of integration with lower performance variation.

Cost: Fully automated sub-assembly batch process reduces manufacturing costs.

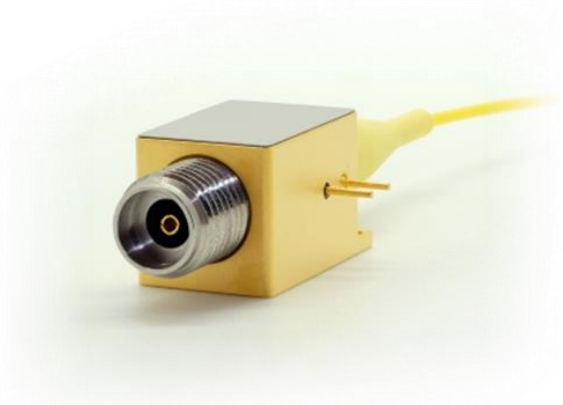
Customization: MMIC replacement for frequency specific applications.

Conclusion

In the framework of ESA project, **Albis Optoelectronics manufactured**:

- High power packaged PD:
  - Responsivity: 0.8 A/W;
  - Bandwidth: 20 GHz;
  - RF linearity: 50 mW.

- Efficient SWaP broadband packaged PD:
  - Responsivity: 0.8 A/W;
  - Bandwidth: 40 GHz.



Currently the project of MMIC integrated packaged PD for broadband and narrowband matching is on-going.

Thank you

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